

## WHAT IS CLAIMED IS

1. A method for producing lightweight, high strength carbon aerogel composites, comprising:

infiltrating a polymer liquid into a pre-formed polymer foam, or fiber-mat,

allowing the liquid to gel such that it encapsulates at least part of the pre-formed polymer foam or fiber-mat,

drying the gelled composite such that the surface tensile forces are reduced, and pyrolyzing the dried composite wherein both of the polymers decompose simultaneously such that the polymers remain essentially in contact at their interfaces.

2. The method of Claim 1, additionally including forming the polymer liquid from an organic gel precursor.

3. The method of Claim 1, additionally including forming the polymer foam into a pre-formed organic polymer form.

4. The method of Claim 1, wherein allowing the polymer liquid to gel is carried out at a temperature of 80°C and a time period of 110 minutes.

5. The method of Claim 1, wherein drying the gelled composite is carried out by any method that limits the shrinkage of the gelled composite.

6. The method of Claim 1, wherein drying the gelled composite is carried out by evaporation.

7. The method of Claim 6, wherein evaporation is carried out at a temperature of 20°C to 80°C and for a time period of 12 to 48 hours depending on the composition and size of the gelled composite.

8. The method of Claim 1, wherein pyrolyzing the dried composite is carried out in a furnace at a temperature of 700 to 1100°C and for a time period of 8 to 12 hours.

9. A lightweight aerogel composite material composed of an organic gel precursor infiltrated into a pre-formed organic polymer foam, which is gelled, dried, and pyrolyzed to form a glassy carbon material composed of the two organic materials.

10. The lightweight aerogel composite material of Claim 9, consisting of a matrix of porous carbon aerogel, reinforced by solid carbon struts or fibers, all in intimate contact, whereby strength of the composite material is maximized.

11. A method for producing lightweight, strong carbon aerogel composites, comprising:

providing an organic gel precursor,

providing a pre-formed organic polymer foam or fiber-mat,

infiltrating the organic gel precursor into the pre-formed organic foam to form a composite material,

providing for gelation of the thus formed composite material,  
drying the thus gelled composite material, and  
pyrolyzing the dried composite material, whereby a carbon aerogel  
composite is produced which consists of a matrix of porous carbon aerogel,  
reinforced by solid carbon struts, all in intimate contact so that the strength of the  
composite is maximized.

12. The method of Claim 11, wherein drying is carried out by any  
method that limits the shrinkage of the gelled composite material.

13. The method of Claim 11, wherein pyrolyzing is carried out so as to  
reduce the dried composite material to a glassy carbon form.

14. The method of Claim 11, wherein gelation is carried out at a  
temperature of 20°C to 80°C and for a time period of 30 to 180 minutes.

15. The method of Claim 11, wherein drying is carried out by  
evaporation at a temperature of 20°C to 80°C and for a time period of 12 to 48  
hours.

16. The method of Claim 11, wherein pyrolyzing is carried out at a  
temperature of 700 to 1100°C, and a time period of 8 to 12 hours.

17. The method of Claim 11, wherein the organic gel precursor is  
selected from materials of the group consisting of resorcinol-formaldehyde,  
phenol-formaldehyde; and wherein the pre-formed organic polymer foam is

selected from the group consisting of resorcinol-formaldehyde, phenol-formaldehyde, poly-isocyanates, poly-urethanes, other aromatic hydrocarbons, and heterocyclic compounds, eg. furan.